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ABSTRACT

The Basic Skills Keyboards is a software program that features a variety of game files presented in ways tied to the cognitive deficits associated with autism. The program is based on the hypothesis that such students have problems with cause-effect, means-end, and personal agency, and would develop a working knowledge of these relationships via the program. Operation and development of the approach are reviewed, and results of a pilot application suggest that the method has promise. Further development of the program resulted in five additional files geared to a more complex level of functioning. (CL)

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Software For The Atypical And Severely Handicapped Student

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Abstract

The "Basic Skills Keyboards" program was designed for atypical and autistic students. Pilot work with elementary and high school age students has shown that it is useful: a) with students lacking prerequisite skill for independent use of commercial software; and b) with students demonstrating "Gestalt" cognition as described in current literature on autism. Use of the program increased the students' attention; response rate; intentionality; problem solving; and referential communication. It also served as an effective stimulus for social interaction; pragmatic communication; and behavior change. The program incorporates design characteristics patterned after recommendations found in the literature on autism. It was designed by a public school special day class teacher using a single-stroke Terrapin Logo keyboard. Prototypes of supplementary curriculum materials which reinforce learning and shape independent functioning exist.

The "Basic Skills Keyboards" program borrows the high-impact visual display; the flexible graphics; and the simple programming techniques of Terrapin Logo to create a do-it-yourself stimulus-response tool for teachers. Anyone with beginning knowledge of Terrapin turtle graphics can individualize the program to fit his or her own needs.

Designed by a special day class teacher working in a severely handicapped public school classroom, it has proven useful with students who lack the cognitive, attentional, and behavioral prerequisites necessary to use commercial software. It has also served as a

successful stimulus for shaping social interaction, pragmatic communication, and behavior change in both low and high functioning students. Its usefulness as an independent pre-vocational task is being explored.

The "Basic Skills Keyboards" program provides a learner-centered experience in which:

1. The teacher pre-programs all the graphic stimuli.
2. The student operates the keyboard independently.
3. The teacher facilitates the student's performance as needed with visual, verbal or physical prompts.
4. The student makes responses which are characterized by progressive improvement in the areas of: attention; response rate; intentionality; problem solving; and referential communication.
5. The teacher alters the keyboard as needed to facilitate the desired behavior changes in the student.

A variety of game files exist for the user to choose among. Each has its own distinctive set of graphics laid out in its own distinctive pattern. The various visual displays currently available are: color screens; lines of various types in graduated size sequences; simple representational shapes; geometric shapes; letters; numbers; and filled-in blocks. Any one of these game files can be edited by anyone on the spot to accommodate or challenge the users' response pattern.

Rationale

Most available software assumes that:

1. The user can discriminate, remember and choose target keys as needed.

2. The user can comprehend and follow teacher's auditory directions.

3. The user can solicit help as needed.

4. The user can conceptualize relationships among program elements.

5. The user can develop problem solving strategies.

Unfortunately, students with autism or similar learning needs are often impaired in most if not all of these skills regardless of their age. This is often true even in students who display isolated areas of high functioning that hint of high potential.

The "Basic Skills Keyboards" program is an experiential discovery program intended to provide such students with as optimal a learning environment as possible by circumventing the need for such pre-existing skills. It was designed to incorporate guidelines currently found in the literature on the cognitive deficit in autism.

As explained most clearly by two key ideas people in the field (Prizant & Schuler, in press), autistic individuals seem to exhibit a relatively inflexible mode of information processing. These researchers term it "Gestalt" processing, meaning to convey that autistic individuals treat information that comes in to them as a whole.

Autistic individuals appear to be unable to break information down into its component parts. As a result, they are unable to see relationships between the parts that make up the whole. They are unable to see how environmental factors affect the parts that make up the whole.

Because of this, autistic individuals are least able to function when they are expected to process stimuli which are ephemeral, part of an interrelated sequence that moves rapidly past them and is gone.

And yet, as Prizant and Schuler point out, most subtle communication and socialization requires the capacity to quickly analyze and respond to such fleeting sequences. And, in the experience of the author, all too often so do the learning stimuli most readily available to special educators for the purpose of direct instruction, especially at the computer.

In their recommendations for remediation, these authors suggest the following strategies:

1. Present students with whole, static sequences spread out in space.
2. Generate authentic interest in the student.
3. Make the activity learner-centered; not teacher imposed.
4. Teach a skill that has functional value i the immediate environmental culture.
5. Present such consistent, clear responses to the students' behavior that they are able to form hypotheses about what they are personally experiencing.
6. Incorporate the use of language to mediate continued growth in thinking skills and problem solving skills.

In their own work, both researchers are primarily focused on language acquisition and communication. However, it seems feasible that these same characteristics would be relevant to curriculum materials intended to enhance cognitive functioning in individuals with autism and in others whose learning needs appear to be similar.

The "Basic Skills Keyboards" program is an attempt to create a software program to do just that. It is intended to be used in an environment where adults see as part of their role the job of facilitating enhanced performance and thinking skills.

Operation

The operation of the "Basic Skills Keyboards" program is very simple. Each time a key is pushed, a graphic line appears on the monitor. Each key consistently produces its own particular pre-programmed graphic each time it is pushed within as particular file. The graphic image remains static on the screen until another key is pushed. Once another key is pushed, a new graphic either replaces or alters the original image, depending upon the complexity of the visual display.

There is no movement on the screen other than that directly caused by the student. The makeup of the "whole" image which appears on the screen at any point in time is completely determined by the specific sequence of keys which the student has chosen to hit. The student has complete freedom to look at this "whole" image as often and as long as desired, and to alter it whenever desired. In the process, the student becomes focused on the changes occurring as a direct result of his or her actions.

Thus, instead of being threatened by the changes, the student strives to gain increasing control of the changes. This develops a self-stimulated, sincere interest in "thinking about the parts". It provides the learner with vivid, static whole images to relate to. Yet, it changes the component parts of the images in a sequence of experiences so close in time, so non-threatening in delivery, that the learner has maximal opportunity to interrelate each new experience with what preceded and will follow. Thus, the learner has maximal opportunity to form hypotheses about cause and effect; change; agency; and the interrelatedness of the parts which make up the whole.

Development

The program emerged out of the author's three-year experience as teacher in a specially funded interagency project involving Marin County Office of Education and Marin County Community Mental Health Services.

The majority of the low-functioning teenagers who were served by this project fit the criteria for Subgroup 2: Primitive Autism, in the categorization schema described by Dr. Bryna Siegel and her associates in the Stanford Autism Research Project (Siegel, Anders, Ciaranello, Bienenstock, & Kraemer, 1986). These students functioned at a severely retarded level; displayed repetitive motor stereotypies; were largely preoccupied in their own world; and were spontaneously mute but were trained to make one or two word utterances involving a limited vocabulary in familiar contexts. In addition, they did not have functional independent object relationships.

In an attempt to increase the quantity and complexity of the students' independent object responses, the author designed two simple files to facilitate independent keyboard functioning on their part:

1. COLOR.GAME: Each keystroke changes the background color displayed on the screen.

2. DRAWING.GAME: Each keystroke lays down one brightly colored line extending from the end of the previous line against a black ground.

These files were programmed using a single-stroke keyboard format called Superturtle!!© which was designed by Dr. James Evans of Marin County as a tool to help teachers create their own keyboards easily.

The author used this as a prototype and simply attached the desired procedures for each graphic stimulus to the selected symbol keys using the "C" or command procedure. Once that was accomplished for the entire keyboard, a name was given to that particular keyboard, and it was saved permanently to disk as a file, without losing or harming the original keyboard file which was used as a prototype.

Pilot Application

The hypothesis that these files would produce enhanced object interactions was tested out in an informal pilot study in a social playroom setting where these original students spent two 45-minute periods a day. They were given free access to the computer; were often invited to use the computer; and were supervised indirectly by an adult who remained at a distance except for intermittent prompts, helping interventions or direct verbal communications.

The duration of this informal pilot experience was only the last three months of the project, but it definitely gave evidence that using the computer in this way with such a population held promise. All the students performed more willingly, more independently and more competently at the computer than they had previously with any manipulative objects available to them. They displayed sustained interest; good visual focusing and tracking; and intermittent novel behavior. Their interest had not plateaued at the end of the time, but was still building. Examples of some specific student changes observed follow:

1. Baseline: Student A's spontaneous playroom language usage was limited to noun labels and "want (noun)."

At computer: Student A spontaneously initiated all of these

phrases i a number of different sessions each: "me...lines" (directly adult's attention); "up... line" (descriptive); "line...(com)puter" (pointing); "lines on lights" (pointing to fluorescents); and "lines" (announcing his intent to walk to the computer to take a turn, which he would then do).

2. Baseline: When directed, student B usually remained at a distance from peers, staring into space, and tapping small objects on a surface below eye level.

At computer: Student B functioned independently for up to 15 minutes at a time, using varied finger movements; once he spontaneously approached and touched a peer at the computer on the shoulder and waited proximate for the turn he had thus initiated a request for; once he independently replicated with paper and crayon the simple design he'd just made on the computer after having been prompted to do so in previous sessions only twice.

3. Baseline: Echolalic and angry, Student C needed prompts to ask for help when he was unable to continue his task at structured manipulative sessions.

At computer: Student C spontaneously and loudly called "I want help" to adult at a distance from the computer every time he really needed help to continue.

4. Baseline: Oldest but lowest-functioning in the group, Student D was only interested in sensory properties of objects.

At computer: Initially, Student D refused to approach it. During the first month he was placed on a structured food reinforcement program. He would "poke" at the keyboard once or twice without

looking at the screen for each food reward. During the second month, he began to look at the screen to watch for the effect and increased his key pushes to 10 or more per food reward. Early in the third month, he began to sit at the computer and concentrate on the screen as he pushed keys for up to 1.5 minutes per food reward. Toward the end of the third month, no further food reinforcement was necessary. He spontaneously sat down at the computer and focused intently on the screen while pushing the keys in a steady rhythm, for over 5 minutes each on two occasions, and for over ten minutes on another.

Further Development

At the end of this project, the author was assigned to a primary-level special day class in a community setting.

The population here was composed of verbal 8-to 14-year-old severely atypical students. Among them were students who met Dr. Siegel's criterion for Subgroup 1: Echolalic Autism, as described at the State NSAC conference at Stanford this spring. (Siegel, Anders, Ciaranello, Bienenstock, & Kraemer, 1986) They demonstrated verbal repetitions and ritualized play; lacked real imagination; and showed an increase in stereotypies with excitement. One seemed to meet the criteria for Dr. Siegel's Subgroup 3: Schizotypal Autism. This student had high functioning language, but was socially withdrawn, was anxious, and was driven by obsessive though processes. A few others seemed to meet the criteria for Dr. Siegel's Subgroup 4: Negativistic Autism. They were very difficult to shape; undermined behavioral programs; and were easily overstimulated by social contact. The remaining students showed various patterns of atypical retardation due to head trauma; seizure disorder; or the suspected presence of an uncommon medical syndrome.

Since these students were capable of functioning at a readiness to primary level in a parallel or adapted academic curriculum, there was a chance that the Basic Skills Keyboards program would be too simplistic and therefore useless. However, this did not prove to be the case.

The author devised additional files suited to their more complex level of functioning:

1. FIVE.FEATURE.FACE: Two five-key faces are laid out on each row with a black set providing an eraser for every6 feature.
2. THIRTEEN.FEATURE.FACE: One ten-key face is laid out on each row with a black row providing an eraser for every feature.
3. COLOR.SHAPE.MATCH: Three geometric shapes in each of three screen positions are laid out along each row, with a black row providing an eraser for every shape in every position.
4. UPPERALPHA: A white uppercase letter corresponding to the key pushed is drawn in the center of the black screen in correct stroke sequence.
5. COUNTING.GRID: There is a left to right pattern of ten small filled-in rectangles on each row.

Second Application

These game files were used selectively and intermittently with this population over a two-year period. All the students exposed to them in a relaxed manner with sufficient facilitation have consistently increased the variety, frequency and intentionality of their responses. All have moved to a level of increased dicision-making (they know what graphic they're after); increased prediction (they know where they think it is); and increased problem solving (they keep on looking even when they guess wrong).

With this population, new applications for the program emerged. It proved useful as a visual tracking stimulus; as a visual-motor imitation stimulus; as an introduction to the appropriate use of the computer; as a leisure-time reward activity; as a training activity for independent functioning; as a social-interactions stimulus for pairs of students; and as a safe outlet for overwrought students. It also provided an excellent transition into the use of the commercial word processing program, Magic Slate:

1. Baseline: Student E refused to let teacher direct or influence his key selection in any way and insisted upon following perseverative ritualized patterns.

At computer: After exposure to a structured shaping program in which desired visuals were used as reinforcement for compliance and exploration, Student E expanded his self-directed exploration to the entire keyboard. He successfully transitioned to the use of Magic Slate for imitating modeled full syntax.

2. Baseline: Student F was unable to replicate or imitate any kind of symbol sequence using any means.

At computer: After many uninterrupted sessions of exploration with various files, Student F successfully transitioned to the use of Magic Slate for imitating modeled three-letter words. She also discovered self-correction strategies and cursor movements independently without training.

In addition, the use of the program with this population stimulated the development of supplemental curriculum materials which provide practice in vocationally-relevant skills. These include:

1. A set of painted cardboard manipulatives in the same colors and shapes as the graphics in each of the game files. These are used to replicate the visual image from the screen onto the black basemat provided. Given such practice manipulating the changing elements as they are modeled on the screen, the student experiences making position; size; color; and shape discriminations at a self-directed pace. This reinforces the development of a working knowledge of ideas they cannot conceptualize.
2. A set of dotted-line printed models of the various screen options available in any one game file. These are used to reproduce given static screen images with corresponding color markers.
3. A set of picture-cued data sheets. These are used to record the absolute number of a graphic element displayed on a given static screen; or the number of sequential occurrences displayed in "x" number of turns or "x" amount of time.

Conclusions

The original hypothesis underlying this computer application was that students who had problems with cause-effect; means-end; and personal agency would develop a working knowledge of these relationships from experiences inherent in the program even if they remained unable to conceptualize these relationships. It was anticipated that generalization to other operations would occur because the student's sense of personal power, competence, and options would have been enhanced through doing.

It is proposed that adequate anecdotal evidence exists from the informal applications carried out to date to prove all claims make:

1. "Basic Skills Keyboards" program serves a directly useful remedial learning function itself.
2. "Basic Skills Keyboards" provides prototype for cognitive curriculum materials for autistic individuals and others with similar learning needs.
3. Gains from "Basic Skills Keyboards" carry over to other performance in the classroom besides the computer.

In order to test these claims further, however, two additional things are needed. First is a management system to collect data on each student's performance and provide summary reports of frequency, duration and patterns of response. Once this is added to the program, it will be possible to objectively measure the effectiveness of the program with the population described. I will also be possible to measure the effectiveness of the tool in primary prevention with very young children suspected of being learning disabled; language delayed; culturally deprived; or developmentally disabled.

The other need is for an operating system that would increase speed and ease of: (a) loading the program language; (b) selecting files; and (c) replacing files, while maintaining the flexibility of the on-the-spot editing capacity.

Once both these systems are in place, controlled trails in special day classes and select day care centers would provide valuable, definitive data about the usefulness of this tool as a remedial agent for students and children who have potential but are unable on their own to learn some of the requisite skills for developing it.

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